The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

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SMOKE RINGS

Our Cover Picture

● THE OLD "Invicta" locomotive, shown in this photograph, is notable not only as a typical example of the earliest locomotive practice, but also because of its association with the first railway in the world to run a regular passenger-carrying service. It was built in 1830 by George Stephenson, and bears many features of similarity to the *Rocket*, but the forward disposition of the cylinders, and the coupled driving wheels, betoken its later date and more advanced development. The cylinders are 10 in. bore by 18 in. stroke. A feature of interest concerning the Canterbury and Whitstable Railway, on which this locomotive ran, was the steep gradient leading out of Canterbury, up which the trains were hauled by a stationary engine, the rest of the journey being made under their own steam. The engine is a familiar sight to Canterbury visitors, where it is exhibited in the main road near the railway station, and is kept in a fairly good state of preservation by frequent coats of paint on all working and non-working parts.

The Chichester Exhibition

● WE WOULD remind readers of the forthcoming exhibition organised by the Chichester and District Society of Model Engineers. It will be held at the Assembly Rooms, North Street, Chichester, during the week commencing February 14th next. The opening ceremony will be conducted by His Grace the Duke of Richmond and Gordon, at 3 p.m., and public admission will begin at 5 p.m.

The principal feature will be the Competition section, the judges of which will include Messrs. E. T. Westbury and J. N. Maskelyne. Preliminary reports seem to indicate that the exhibition will be a momentous event that should not be missed by anyone who can possibly pay it a visit.

The Forgetful Customer

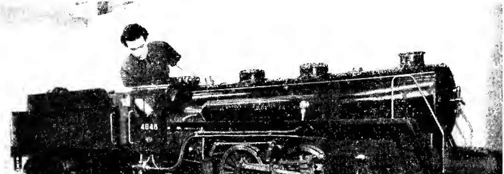
● MESSRS. CORBETT'S (LATHES), of Stanton Hill, Notts, are very anxious to get into touch with Mr. W. C. Hobb, who wrote to them regarding a $3\frac{1}{8}$-in. lathe but did not give his address. If this note should meet Mr. Hobb's eye, we hope he will write to the firm again and give them the obvious means of enabling them to reply to him!

Traction Engines at the "M.E." Show

● WE ARE hoping that this year we may be able to have a number of model traction engines running during the "M.E." Exhibition. We had intended to put this idea into effect last year, but circumstances did not permit it. Our Exhibition Manager would be grateful for offers from readers who would be able and willing to lend and operate model traction engines during the exhibition. Offers should be addressed to Mr. E. D. Stogden, Exhibition Manager, Percival Marshall & Co. Ltd., 23, Great Queen Street, London, W.C.2.

An Unconventional Workshop

● RECENTLY, we paid a visit to the workshop of Messrs. David Curwen, at Baydon, near Marlborough, Wilts., and were pleasantly surprised at what we found there. To begin with, the locale is unusual in that is it entirely surrounded by typical Wiltshire downland country, an ideal setting for a truly rural mode of life rather than for a busy, if small, engineering workshop!



A 10¼-in. gauge American-type 4-4-2 *locomotive built by Messrs. David Curwen, of Baydon, Wilts.*

The shop itself consists of a large army hut of very robust construction, warm and weatherproof, well-lighted and comfortable. It is equipped with a well-chosen selection of lathes, millers, drilling machines and other tools, and power is derived from an oil-engine which drives an electric generator. The staff comprises, perhaps, a dozen men.

Work was proceeding upon a number of locomotives ranging from 3½-in. to 10¼-in. gauge; most of these engines were in for seasonal overhaul and repair. A 10¼-in. gauge version of "Hielan' Lassie" was awaiting attention after about eight months of strenuous work at Weymouth. An American-looking 4-4-2 engine for 10¼-in. gauge, similar to one exhibited at last year's "M.E." Exhibition—illustrated on this page—was under construction, and we were much interested in some novel features on it, especially its main axleboxes.

The Salving of a Floating Dock

● THE ADMIRALTY have recently released the story of the salving of Floating Dock No. 8. The chief interest centres upon the colossal problem to be met and the preparations made for the operation. An Italian air attack in 1940 had left the huge dock in a state of irreparable damage with the uppermost part of its walls a few feet under water and blocking access to a berth in Malta Harbour. There it remained until recently, denying to the Admiralty a berth required for a new floating dock. It was strained by bomb damage and years of corrosion in salt water. The problem was to raise this structure, 960 ft. long, 180 ft. broad and 70 ft. deep. Complete removal was essential to clear the berth, and sufficient bouyancy had to be provided to enable the wrecked dock to be towed safely across Grand Harbour, Malta, in which it had lain so long.

By the end of 1947, the dock had been cut into three pieces by underwater burning; there were two identical parts, called the North East and South West parts, and a central portion. Various schemes of salvage were discussed and—this is what interested us, particularly—models of the dock were constructed by the Director of Naval Construction and used to demonstrate possible movements of the dock during lifting; from the study of these, suitable salvage schemes were evolved in detail.

The work was eventually completed successfully, thanks to the excellent team-work between the Boom Defence Department, which undertook the actual lifting, Naval Construction Department, which made the models, did the calculations and advised generally, and Malta Dockyard, whose local facilities were invaluable.

Mr. H. C. Wheat

● THE WORTHING and District Society of Model Engineers has sustained a grievous loss by the recent death of Mr. H. C. Wheat, one of its founder members, at the age of 74. Mr. Wheat held the posts of hon. librarian and exhibition secretary to the society, and he was well known to many model engineers in the Worthing, Hove and Brighton districts. He was a contributor to our associated periodical *The Model Railway News* and an exhibitor at THE MODEL ENGINEER Exhibition in 1947 and 1948. His meticulous craftsmanship, enthusiasm for the hobby and his genial personality will be missed by his friends and colleagues.

A Fowler Steam-Roller

by M. V. Pink

THE drawing reproduced on this page shows a Fowler compound type steam-roller. This engine, manufactured in approximately 1922, Makers No. 15902, is a 17-ton roller, non-superheated, and is fitted with a scarifier on the right-hand side near wheel.

The design is similar in many features to all Fowler engines, and has the standard type Fowler cylinder block and motion, the lubrication of which is carried out by an oil pump, situated at the rear of the cylinders, and worked from the valve spindle.

The boiler working pressure is 180 lb. per sq. in.

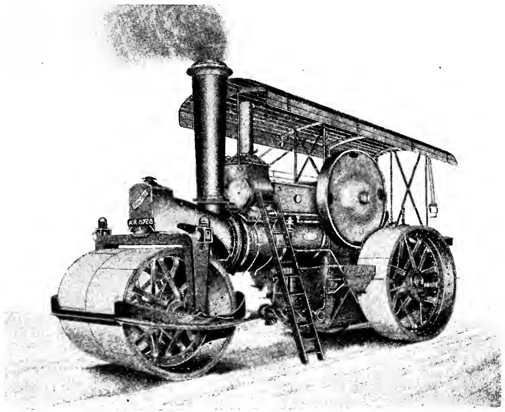
Movement of the engine is effected through a series of gear-wheels, and the drive actually is taken on the left-hand side of the rear axle. As with all "one-sided" driven engines, this tends to make the steering a little difficult, but the trouble may be overcome by releasing the left-hand side rear wheel from its driving axle.

The "front end" design is somewhat different from other engines of this kind, in so far as the smokebox is very short indeed. This does not affect the "steaming" to any great extent, provided the tubes are kept clean, and the exhaust pipe from the cylinders to the chimney is given frequent attention at regular intervals.

The engine shown has been in continuous use on road work, over the past 30 years, but the maintenance repairs have been very light, and the original steel firebox is still in service, with every appearance of enduring for another such period of time.

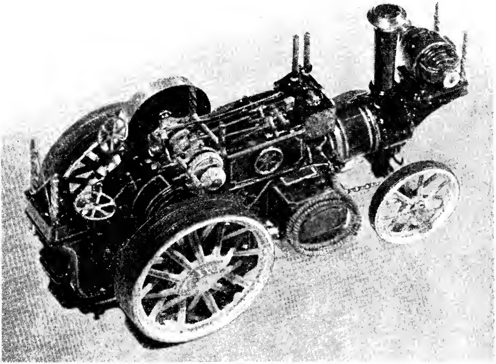
The heaviest repair that has been necessary to date, was the re-shoeing of the front roller and rear wheels, and these will shortly require attention again.

Particulars and dimensions are as follows :— Diameter of front roller, 4 ft. ; Width, 4 ft. 3 in. ; diameter of hind rollers, 5 ft. 7½ in. ; Width, 1 ft. 6 in. ; Overlap, 2½ in. ; Wheel base, 10 ft. 8½ in. ; Cylinders, bore, h.p., 5¾ in., l.p., 10 in. ; Stroke, 10 in. ; Height to top of flywheel, 8 ft. 1½ in. ; Height to top of chimney, 10 ft. 1 in. ; Capacity of tank, 122 gals. ; Governed speed, 170 r.p.m. ; Belt h.p. at governed speed, 30 ; Road speed (slow), 1.17 m.p.h., road speed (fast), 2.62 m.p.h.



A "SOLID" MODEL TRACTOR

by B. A. Brock



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THE "solid"—that is, a non-working—model has come very much to the fore in recent years, especially in the case of the model aeroplane; in fact, the model aeroplane enthusiasts seem to have been the first to make use of the term "solid model" as a generic one to exemplify a particular class of model making.

Those who have spent years building beautiful working-model showman's engines to some scale like ½ in. to 1 ft., will, no doubt, disapprove of mine being a non-working model, but I think it is almost unique in the fact that it is to a scale of 6 ft. to 1 in., the canopy being 4½ in. in length. For years I have made the usual 1/72nd scale model aircraft, so the choice of that scale for the traction-engine came almost automatically!

Missed Features

I feel that it is a great pity that nearly all large working-model showman's engines are made to some free-lance design and often seem to miss the nicest features of the full-sized prototypes. In my model I have, therefore, tried to follow the design of a Burrell as far as the scale and my collection of photographs would allow.

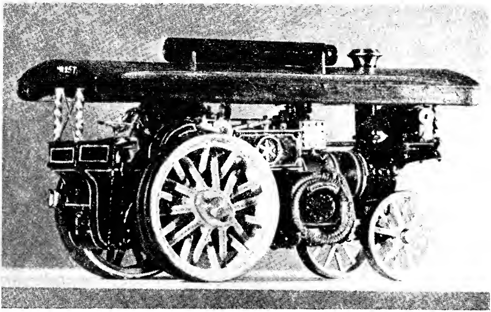
It is built almost entirely of brass and tinplate, apart from the flywheel which is of dural to get a better effect of a polished rim, and also the gear-wheels which are of knurled dural.

The whole model is soldered with the exception of two 10-B.A. bolts, one to hold the dynamo on the front mounting and the other to attach the boiler to the front water-tank. I found that these took so much heat to solder that smaller fittings began to come off in the attempt.

The road wheels were built up from brass rims and hubs, and tinplate spokes in a jig and did not present as much trouble as was anticipated.

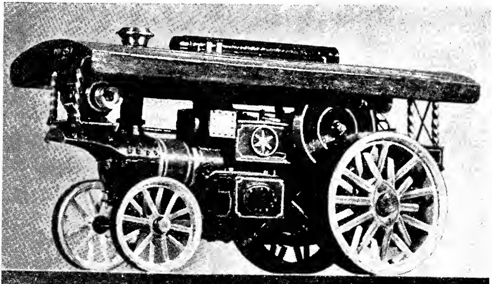
The crankshaft was originally made to turn with the flywheel but as it proved impossible to keep the crossheads on the slidebars, I decided to make the whole lot fixed rather than make parts of it out of scale.

Most of the essential fittings such as the water injection system, rear brakes, safety-valve, governor, etc., have been included and I think that though the maroon and yellow paint have given it an effective finish, the orange and red lining has suffered a little from the diminutive scale.



The only parts which I did not make were the steering-chains and the coal! The driver's seat has still to be made.

My next model traction-engine will probably be a Fowler agricultural type to the same scale, though when the time, drawings and machines permit, it is still my ambition to make a large coal-fired working model.



Backhead Fittings

for "Maid," "Minx" and "Doris"

by "L.B.S.C."

As the same sized fittings will be O.K. for the 5-in. gauge engines as well as the $3\frac{1}{2}$-in., one description will do for the lot, and time will be saved. Most of the 5-in. gauge locomotives that I have seen, have had backhead adornments that were far too large and clumsy; a case in point was the Carson "Precursor" purchased, very much used, by Mr. R. C. Hammett. I overhauled this engine as a friendly job after he had put our air-raid shelter in, at the latter end of 1940. It had the most awful conglomeration of pipes, valves, blobs and gadgets on the footplate, that I had ever seen on a similar engine of the same type; I scrapped the lot, and replaced them with a few small ones, which not only did the job, but looked neat and tidy. It isn't a practical proposition to make "scale" fittings, even in 5-in. gauge, for actual efficient operation; but there is no need to make them any bigger than necessary. With the exception of a water-gauge with a little bigger diameter glass, for easy reading and more accurate indication of water-level, the sizes of fittings I usually specify for $2\frac{1}{2}$-in. gauge engines are also suitable for $3\frac{1}{2}$-in. and 5-in. It will probably give beginners a shock when they realise that a gauge-glass of $\frac{3}{16}$ in. diameter, on "Maid" or "Minx," would be $2\frac{1}{4}$ in. diameter on a full-size "L1," and 3 in. diameter on "Doris's" big relations! I've never seen glasses that size on full-size locomotives, even in dreams; and the driver and fireman would need hands like those of a giant gorilla, to turn handwheels 6 in. and 7 in. diameter, by gripping them in the manner usually observed among enginemen.

How to Set out the Fittings

The illustration given here, shows the way to arrange the usual fittings on the backheads of "Maid of Kent" and "Minx"; the outline shown is the "Maid's," with a Belpaire firebox in full lines, and the roundback in dotted lines. The fittings can be arranged in the same way on either; and a similar layout with slight variation will suit "Doris," only the fittings will be a little closer together, as the backhead is smaller. The usual combined turret and whistle valve is screwed into the top of the wrapper sheet, the hole for the stem being as close to the back as possible, so that the screw threads are tapped into the backhead flange. There are three unions on the turret; one of them may be connected to the steam-gauge by a $\frac{1}{8}$-in. pipe and bent to form a syphon. Builders who have adopted the Belpaire firebox may, if they so desire, screw an elbow with a union, into the top left-hand corner, and connect the steam-gauge syphon direct to it, which makes a slightly neater job In that case, a blank cone can be attached to the union on the turret, to close the aperture; or it may be used for the pipe leading to the driver's brake-valve, if steam brakes are fitted. I have shown the gauge in a position where it can be easily seen from the driving car, out of the way of both reversing-lever and injector steam valve; but if you fancy any other position, why, go ahead—it doesn't affect the operation.

The pipe from the second union on the turret, on the opposite side goes to the union on the blower-valve already fitted; and the third pipe is taken down below the footplate, to a big whistle.

Water-gauge Whimsicalities

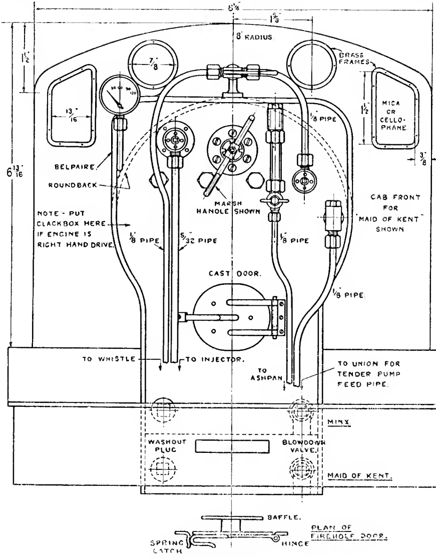
The water-gauge can be fitted to the right of the regulator handle, between it and the blower-valve; it has a $\frac{3}{16}$-in. glass, with big waterways through the fittings, and a blow-down valve with a cross handle, which some folk find more convenient than a knurled wheel, though the latter may be fitted if preferred. I have purposely shown a short glass, as in full-size practice; and it is set at such a height, that as long as you can see the water in it, everything is O.K. If the water goes out of sight in the top nut, the boiler will probably start to prime; whilst if it should go below the bottom nut, it would be a good policy to dump the fire without twice thinking about it! In days gone by, when I sometimes visited clubs and exhibitions, I have seen little locomotives fitted with over-long gauge glasses that still showed water when the level was below the crown sheet. This is misleading to a strange driver, and on more than one occasion has resulted in a burnt and collapsed firebox.

Another thing that beginners often fail to take into account, is that small diameter water-gauges are subject to the effects of capillary attraction, and usually show a higher level than the water in the boiler. Any tyro can test this for himself, with a glass or cup full of water, and a bit of glass tube, such as we use for gauge-glasses. If one end of the tube is dipped into the water, same will promptly rise in the tube, from $\frac{1}{8}$ in. to $\frac{3}{16}$ in. above the level of the water in the cup; and the result is the same, no matter how far the open end is below the surface of the water. Exactly the same state of affairs takes place in a little water-gauge attached to a boiler, and I always allow for it.

Dry Steam for the Injector

The injector steam-valve should be fitted on the left of the regulator handle. It is attached to the backhead by a flange, with four screws, instead of being screwed in direct. The reason for this is that it is furnished with an internal pipe, with a bent end going up into the dome, as

in full-size practice, so that the injector gets dry steam. If water goes over with the steam, it causes the injector to spit out and splutter at the overflow, and keep on " knocking off " ; although it restarts automatically, if properly made, the feed is what the kiddies would call " all over the shop." pump is seldom or never used ; in fact, fitting it is merely a kind of " insurance." It comes in handy if a raw recruit lets the steam pressure and water level fall together, and there isn't enough steam to work the injector. Note—fit it on the opposite side to the reverse-lever ; if you are



How to arrange the footplate fittings

In addition to the two clack-boxes or check-valves on the boiler barrel, another is screwed into the backhead, approximately on the centre line ; and this receives the feed from the emergency hand-pump in the tender. Whilst it is really bad policy to introduce cold water into a boiler so close to the firebox, in this case it doesn't matter much, because the emergency making your engine right-hand drive, the clack should go on the left of the backhead, and vice versa.

" Pass, Friend, and All's Well "

Talking about clacks, I enjoyed a chuckle a few weeks ago, when on my way to Ashford and Eythorne, in the wilds of Kent. Although

I never "tread on the corns" of the good folk who specialise in I.C. engines in this journal, I'm not entirely ignorant of that kind of motive-power, and have done a little titivating to the engine of my gasoline cart (Series 2, Morris 12) so that her most economical speed is around 50 m.p.h. The carburettor "notches up," in a manner of speaking, and I don't lose any power. Well, the old girl was doing her steady 50 on a nice open stretch near Maidstone, when I caught up with a small car. I couldn't pass it for a minute or so, on account of traffic coming "up the line," so turned in behind it, and got a view of the driver through the back window. He had no hat, a close-cropped round head, and a pair of rather prominent ears; and the whole lot so reminded me of a boiler-barrel with a clack-box each side of it, viewed from the smokebox end, that I couldn't resist a grin. Instinct told me he was a cheery sort of individual, and so it proved; for as soon as he caught sight of my chariot in his mirror, he started pulling into the near side and waved me on. Directly my road was clear, I "gave her steam" and passed; and as I did so, he turned full face towards me, smiled pleasantly, and waved again, I waved back, and gave a farewell toot as my engine gathered speed. Just an incident on life's highway; but whenever I pass that way, I shall always remember the "boiler with two clacks" and the smiling round face on the other side of them. The owner may read these notes, for all I know; if he does, it will give him a big surprise to learn that the driver of the black saloon car who returned his smile and wave, and gave him a parting salute on the hooter, was the same person who writes them.

Keep the Boiler Clean

One thing which 99 per cent. of small locomotive builders and drivers seem to forget all about, is the necessity for keeping the boiler clean inside, especially in districts where the water contains chalk, lime and other impurities. At my old home at Norbury, boilers required a thorough washout after 20 hours' steaming. In the case of the "Maid" and "Minx," I am specifying a big washout-plug at one bottom corner of the back-head and a blow-down valve at the other; the latter may be either a plain screw-down valve, the plug being operated by a key, or it can be a proper quick-acting blow-down valve as used on full-size engines. The type mostly used on British locomotives, is the "Everlasting" blow-down valve; and by courtesy of Mr. F. S. Lovick-Johnson, managing director of the company of that name who makes the valves in this country, I am enabled to give drawings and instructions for making a weeny valve of the "Everlasting" type, suitable for "Maid," "Minx," and "Doris." If all goes well, these will appear next week. I have here at the present moment, a little "Everlasting" valve made by Mr. Lovick-Johnson himself, the same type used on Southern and L.M.S. engines. It is simple, very effective, easily made (very important, that!) gives a "full throttle" blow-down by one movement of the lever, and yet remains steam-and-water-tight "till the cows come home." Our worthy friend does a bit of locomotive-building himself, in the very limited spare time at his disposal, of which more anon.

Although the illustration shows a firehole door of my pet swing type, with spring catch, builders may, of course, fit any other kind they prefer; but I certainly don't recommend the double sliding type fitted to many full-size engines. It is all right in full size, where there is also an air flap, and baffle or deflector plate over the firehole inside the box; but my personal experience of this type of door is, that in the small size it is an unmitigated nuisance. Just before Christmas, a friend resident in Lancashire, came south on a visit to his relations. He has built a 3½-in. gauge "Royal Scot," with three cylinders, and all the blobs and gadgets of the big sister. Externally, she looks a very fine job, and would get a prize in any competition which was judged by looks and "scale appearance" alone, but she won't go for toffee-apples. My friend has spent best part of eight years on her, and is naturally disappointed with her non-performance, so asked me if I would give her a test on my road, and see if I could diagnose the trouble, which I agreed to do, and she proved a "Royal Spot of Bother."

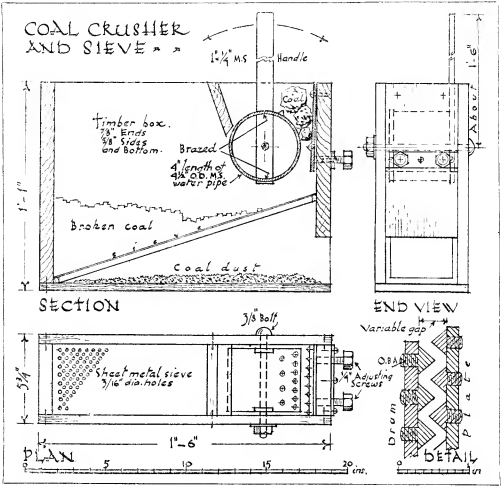
There is no need to detail out all the faults here; suffice it to say there was just one continual roar up the chimney, denoting bad blowing on valves and pistons; but among other faults she had a sliding firehole door which, every time it was opened, refused to shut properly because of coal dust and small chips getting in the slides. When closed as far as possible, cold air blew in between the two halves, right across to the tubeplate, as there was no deflector; and as soon as the engine made her feeble attempt at running, the door started to work open. Nothing of the kind has ever happened on my own engines, which all have the swing doors. These can be opened easily with the shovel blade, for firing when on the run; no cold air can blow straight on to the tubes, because each door is furnished with a baffle; and the door cannot come open "on its own," because of the spring catch. If the boiler starts to blow off whilst running, as is usually the case on my road, the door can be opened as far as the end of the spring catch. It will stay there by aid of the pull of the blast.

To save time when describing the superstructure of the engines, I have included the outline of the cab front of the "Maid of Kent," with dimensions, also the size and location of the cab windows. The front is the same for either Belpaire or round-back boiler. Note, it is wider than the "scale" dimensions of a full-sized Southern "L1," the reason being, that in the small size we have to use proportionately wider wheels, splashers, etc. which means wider running boards; and the cabsides being set at the correct distance from edge of same, gives a wider cab. Next week, details of how to make the boiler fittings mentioned above, with suitable illustrations.

Breaking it Up to Pea Size

Regular followers of these notes may remember that I always advise drivers and firemen of little coal-fired locomotives, to break up the coal to pea-size, and sift all the dust out. Some folk religiously follow the instructions, and never have

any trouble with loss of steam pressure. Others don't trouble, but just break up the coal anyhow, and lose steam either because the lumps are too big (as long as they go through the doorway, that is "good enough"!) and cold air is drawn between them; or else dust and all are shovelled into the firebox, choking the firebars and stopping narrow and deep box, in which is a drum mounted on a spindle. This drum has a lot of pointed studs in it, like a glorified edition of the gadget in a piano organ, or a musical box. A similar array of studs is fixed in a plate on the end of the box, the setting being arranged so that the fixed and moving studs alternate, as shown in the



the draught. Admittedly, it is a messy job attacking bits of coal with a hammer, and then sifting the result; our old and versatile friend Mr. Edward Adams found it so. His engines, like my own, like their coal in the specified pea-size lumps; even the big Mallet, and "Monstrous," the engine with the "dustbin-size" cylinders, much prefer peas to pigeons' eggs. If friend Adams can find a way of doing a job easily and efficiently by aid of some simple mechanical gadget, you can bet your last dollar (if you have one) that he won't hesitate to make it up; the coal crusher and sifter is a case in point—in fact, quite a lot of points, as you'll see from the drawing!

The contrivance consists of a very strong, detail view. The drum is partly rotated or rocked by a long handle, which gives plenty of leverage. The coal, after passing between the studs, falls on to a sloping screen or sieve, which in our friend's case consists of a metal plate full of holes. The dust falls through to the bottom of the box, and the "peas" are left on top of the plate, all ready for use.

Constructional Details

The box is made from 1-in. wood; one of the ends does not come right to the bottom, but an opening is left for the purpose of tipping out the dust. The drum is a 4-in. length of 4½-in. diameter mild-steel water-pipe, furnished with

(*Continued on page* 164)

IN THE WORKSHOP

by "Duplex"

30—Attachments for the Back Tool-post

THE back tool-post that was recently described is designed to carry its turret in a parting tool made of $\frac{1}{4}$-in. square-section material, but as some, apparently, find the grinding to shape of this tool a rather difficult matter, it has been decided to give the constructional details of a turret-head specially adapted for holding the commercial type of parting tool.

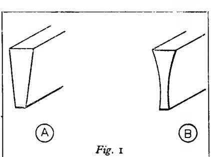


Fig. 1

Parting- or cutting-off tools, of the Eclipse brand, for example, are supplied in sizes and in a form that can readily be clamped in the turret-head of the back tool-post. These tools, which are illustrated in Fig. 1, are made of a special grade of high-speed steel and are supplied in two forms: that shown in Fig. 1 (A) has its flat side surfaces sloping away from the cutting edge in order to provide the requisite clearance; whereas, for this purpose, the blade depicted in Fig. 1 (B) has its flanks hollow-ground. The latter form of tool has been selected for use with the back tool-post, as in the smallest size the blade measures only $\frac{1}{16}$ in. in thickness and $\frac{1}{2}$ in. in depth.

At the outset, the question arose as to whether top rake should be imparted to the tool either by grinding the rake angle or by setting the tool itself at an inclined angle in the turret.

If the tool is ground with top rake, then subsequent grinding of the front face, when sharpening becomes necessary, will make the cutting edge narrower than the shank, thus rendering the tool unsuitable for deep penetration into work of large diameter.

The alternative method of providing top rake

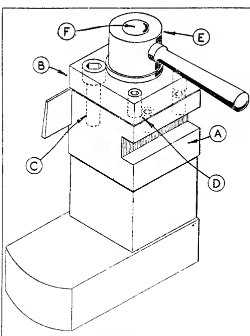


Fig. 2

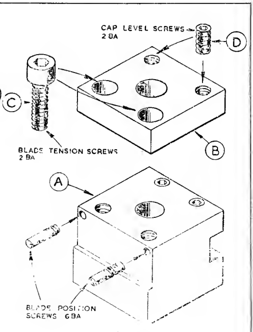


Fig. 3

by tilting the tool means that the height of the cutting edge will vary with the distance the tool projects from the turret ; moreover, the machining of the abutment face for the tool at an inclined angle presents some difficulty for the less experienced worker.

Before arriving at a final decision, a test was made with the tool set horizontally and without any top rake ; as a result it was found that 3 per cent. nickel-steel 2 in. in diameter could be parted off quite readily, and this was accompanied by the formation of a continuous coiled chip.

It was decided, therefore, to machine the turret to locate the tool horizontally and with its cutting edge set at exactly centre height. When sharpening the tool, it should be ground on the end face only in order to maintain the front clearance angle, and the cutting edge can, with advantage, be finished with the aid of a stoning jig. A further gain in using a tool of this form is that it is suitable for machining non-ferrous metals as well as steel.

The standard length of blade of 4½ in. is unnecessarily long for use in the back tool-post, and it may be divided into two by means of a cutting-off wheel mounted on the grinding-head, an operation that it is proposed to describe in a future article, together with the equipment required for the work.

A general view of the back tool-post, equipped with the parting tool described, is shown in Fig. 2 and the constructional details of the turret are illustrated in Fig. 3.

It will be apparent that the turret is now akin to the ordinary English pattern tool-holder fitted to the top slide of the lathe.

The base portion (A) is recessed to accommodate the parting-tool which is secured in place by means of the clamping-plate (B). The two Allen screws (C) act as clamping-screws in connection with the two levelling or fulcrum screws (D), so that when the tool is gripped, the upper surface of the clamp plate lies horizontally in order to afford a level bearing surface for the the clamp-nut (E).

Moreover, this mode of construction ensures that the tool is retained in place and its setting preserved even when the turret is removed from its base.

It might be thought that the side surfaces of the tool should receive greater support, but in practice this has not been found necessary ; in fact, to demonstrate this experimentally, the tool was used successfully to part off lengths of steel bar when clamped solely by its upper and lower surfaces in an ordinary English pattern tool-post. This is quite understandable, for the tool must be set squarely to the work and is not then subjected to side pressure while cutting.

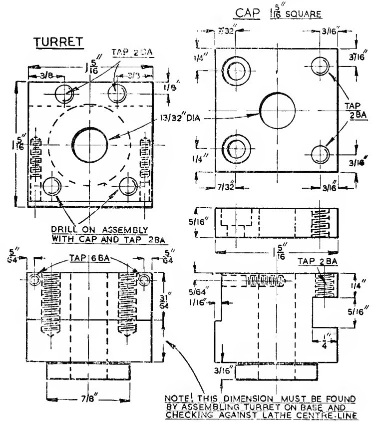


Fig. 4

To ensure accurate location of the tool, the register pegs in the base of the tool-post align the attachment as a whole, and the turret itself is located on the base portion by means of a register-pin which, as in the case of the standard form of turret previously described, automatically maintains the tool at right-angles to the lathe axis.

As the tool is wedge-shaped in cross-section, two grub-screws, shown in Fig. 3, are fitted to the face of the tool slot for the purpose of maintaining the tool in an exactly vertical position when it is clamped in place. In order that the turret may be used for repetition work and for carrying out more than a single machining

operation, it is also equipped with a second tool, as in the original type of turret. If, as previously recommended, a combined chamfering and facing tool is fitted in this position, the back tool-post will alone be capable of machining parts, such as nuts and washers, without the ordinary front tool-post having to be brought into action.

The method of machining the tool slots has already been described and need not, therefore, be repeated, but in this case the chamfering tool is secured by two, instead of three, Allen screws ; this should give an adequate hold, as the side pressure exerted on the tool, when in operation, tends to press it against the vertical face of the tool slot.

Construction

The constructional details and dimensions of the individual parts are shown in the working drawings in Fig. 4.

It will at once be apparent that, as the overall height of the turret has necessarily been increased by $\frac{3}{16}$ in. to accommodate the deeper parting tool, a longer central clamping-bolt or stud must be fitted to afford a firm hold for the turret clamping-nut.

The dimensions of both the clamping-bolt for the " M " type tool-post, for use with the Myford M.L.7 lathe, and the stud for the " D " of Myford-Drummond pattern post are given in the drawings in Fig. 5.

No alteration of the original handled clamp-nut (E) is required, for the aim is, as far as possible, to use a minimum number of standard parts to serve all the back tool-post attachments under review.

The base (A) is most conveniently made from an iron casting, although a piece of mild-steel can be used for this purpose.

The machining operations for facing the surfaces, turning the register spigot, and forming the bore for the passage of the central bolt are identical with those previously detailed for making the ordinary two-tool turret.

The flat surface and shoulder against which the parting tool abuts can be machined with an end-mill or fly-cutter when the turret is clamped at the correct height on the boring table, or the turret can be held in the machine vice attached to the vertical slide in order to facilitate the height-setting operation.

As an alternative, the turret can be secured to a small angle-plate bolted to the cross-slide, and the tool slot is then formed either with a fly-cutter or a circular milling-cutter, as was illustrated when the machining of the rectangular tool slots in the original type of turret was described.

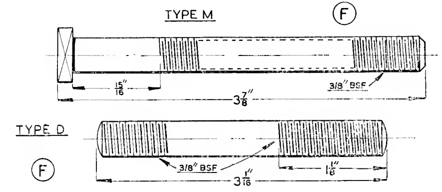


Fig. 5

The clamping-plate (B) should be made of mild-steel, as it is comparatively thin and has to bear a bending stress ; it may be secured in the four-jaw chuck and both the upper and lower surfaces faced parallel and flat, or, if preferred, the work can be carried out by filing and scraping.

The hole for the passage of the central bolt is then drilled and bored to size. The centres for the clamping-screws (C) and the levelling screws (D) are marked-out, centre-punched, centre-drilled, and finally drilled through with a No. 23 drill.

The clamping-plate is now secured in position on the turret base by means of the central bolt, and the tapping-size holes for the clamping-screws (C) are drilled in the turret base with a No. 23 drill guided by the holes previously drilled in the clamp-plate.

The clamp-plate is then removed for tapping the holes for the screws (D) 2-B.A., and the holes to receive the clamp-screws (C) are opened out to the clearing size with a No. 12 drill. The enlarged heads of the clamp-screws are let into the clamp-plate by drilling to a depth of 5/32 in. with a $\frac{5}{16}$-in. diameter drill and then boring to a total depth of $\frac{3}{16}$ in. with a $\frac{5}{16}$-in. end-mill, in order to form a flat seating for the screw and to allow its head to lie flush with the surface of the clamp-plate.

The holes in the turret base to receive the blade-positioning screws are first drilled to the tapping size with a No. 43 drill ; they are then enlarged for part of their length with a No. 34 clearing-size drill before being finally tapped 6-B.A. as represented in the drawing.

To complete the work on the turret base, the holes for the clamp-screws (C) are tapped 2-B.A. and the register-pin is fitted to locate the tool slots truly at right-angles to the lathe axis ; in addition, the holes to receive the two clamping-screws for the chamfering tool are drilled and tapped in accordance with the drawing.

When fitting the turret register-pin, the tool-post base is first drilled right through from above with a No. 31 drill engaging in the existing register-pin hole. The turret, together with its clamp-plate, is then lightly secured in place by means of the central bolt. The next step is to

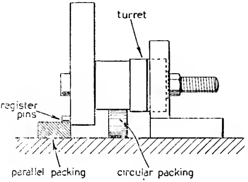


Fig. 6

locate the turret correctly on its base so that it can be drilled in position to receive the register-pin ; this is done in accordance with the method previously described and as illustrated in Fig. 6.

It is important that when in use the tool should lie exactly at right-angles to the lathe axis, for the sides of the tool behind the cutting edge are parallel, and any misalignment in the horizontal plane will cause the sides of the tool to rub in the groove cut in the work ; this not only interferes with the tool's cutting action but at the same time gives a poor finish to the machined surfaces. Although the location of the base register-pins was in the first place marked-out from the rear

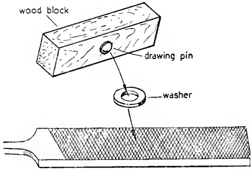


Fig. 7

face of the base casting, it is possible that a small error of position may have arisen when drilling the holes to receive these pins. It is preferable therefore, in the present case to use the pins themselves, rather than the edge of the casting, to afford a datum surface when setting the turret to position the parting tool correctly.

Accordingly, as shown in Fig. 6, the base is set up on the surface plate with the register-pins resting on a parallel packing-strip, and with the upper end of the base casting lying on a short length of round material in order to provide a three-point means of support.

The turret-head is then rotated on the base until, with the aid of a square, the tool face to which the blade-positioning screws are fitted, is found to stand vertically.

When this adjustment has been made, the clamp-nut is securely tightened and the setting is again checked.

To fit the register-pin, the assembly is clamped base uppermost in the machine vice on the drilling-machine table, and a No. 31 drill engaged in the hole previously drilled, is fed through the base into the turret.

To enable the drill hole to be continued right through the turret base, this part is removed and then drilled separately.

The drill hole is next opened out with an $\frac{1}{8}$ in. diameter reamer to afford a well-fitting bearing for the turret register-pin, but to preserve the correct alignment it is essential that the reamer

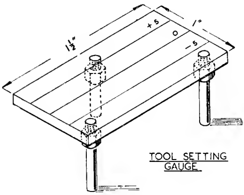


Fig. 8

should be entered from the lower surface of the turret casting.

It will later be found a great convenience if a second hole, at right-angles to the first is drilled through the hole in the turret into the base portion of the tool-post, for this will allow the tools to be turned sideways when not required, thus affording greater working space for threading from the tailstock and other similar operations.

When fitting a handled clamp-nut of the type employed in the present case, it is annoying to find that, when the turret is clamped, the handle projects towards the headstock instead of in the direction of the tailstock as it should. This can be avoided in the first instance if, before the hole to receive the handle is drilled, the nut is screwed home and the position of the handle is then marked for drilling. When, however, a single clamp-nut is used to secure more than one turret, the position of the handle may have to be adjusted by fitting a washer of suitable thickness.

As the clamp-bolt is threaded $\frac{3}{8}$ in. B.S.F.,

having 20 t.p.i., it follows that a full turn of the nut represents a difference of 50 thousandths of an inch in the thickness of the washer, so that the amount by which the thickness of the washer must be reduced to give a partial turn can be readily calculated. When fitting the handled clamp-nut, therefore, either a washer can be specially made and parted off to exactly the right thickness, or an existing washer can be reduced in thickness by the correct amount. For the latter operation, an easy method of filing the washer and at the same time preserving its flatness is to work it backwards and forwards on a flat file by means of a block of hard wood into which a drawing-pin, or a wood-screw and washer, has been fitted, as represented in Fig. 7.

Fitting the Parting-tool

These tools are supplied by the manufacturers with the tip ground to the correct front clearance angle, but it is advisable that the tool, before being clamped in the turret, should have its cutting edge sharpened truly at right-angles to the long axis of the blade by means of the honing jig.

When mounted, the tool should not project for a greater distance from the turret than is necessary for all ordinary parting-off operations. It is also of great importance that the blade should be clamped to stand vertically, so that it has an equal clearance angle on either side; this is accomplished by adjusting the two blade-positioning screws and checking the lie of the blade either by eye or, preferably, with the aid of a protractor standing on the surface plate.

It is worth while carrying out the setting operation with care in the first instance, as this will enable the blade to be removed and replaced in the correct position on all subsequent occasions, provided that the setting of the adjusting screws remains unaltered.

A Tool-setting Gauge

Although the height of the parting-tool in the present instance is determined by the machined tool slot, this is not so in the case of the chamfering tool or the square section parting-tool where packing-strips are used to adjust the tool height. Moreover, when tools of the latter type are resharpened, some height may be lost, as a result of grinding the top face, and readjustment becomes necessary; this can be more readily carried out if some form of height-gauge is used to indicate how much additional packing is required to bring the cutting edge of the tool exactly to the lathe centre height. For this purpose, the small setting-gauge illustrated in Fig. 8 was devised.

In the first place, the tool, while clamped in position in the turret on the lathe, is set to the lathe centre height by means of the surface gauge standing on the lathe bed, or in any other way that may be preferred. The turret is now removed and transferred to the surface plate, where the edge of the tool is brought into contact with the upper flat surface of the setting-gauge, also standing on the surface plate, and the threaded legs of the gauge are then adjusted until the tool makes contact with the zero-line shown in the drawing. The dial test indicator is next brought into use to enable the two lines marked +5 and −5 to be set respectively five thousandths of an inch higher and lower than the zero-line.

The lock-nuts fitted to the legs are thereupon secured, and the device may then be used to determine not only the correct setting of a tool, but also the thickness of the packing required to attain this result.

(To be continued)

"L.B.S.C."

(Continued from page 159)

end-plates and mounted on a spindle consisting of a ⅜-in. bolt. A lever, made from 1-in. by ¼-in. mild-steel, and about 18 in. long, is brazed to one end of the drum. The studs are 0-B.A. steel screws with the ends turned conical, and well case-hardened. The flap-plate, which has similar studs, is screwed to one end of the box, above the hole for discharging the dust, but it is only permanently attached at the top, the lower end being adjusted, so that the size of the broken coal can be regulated to requirements. Adjustment is made by two ¼-in. set-screws running through tapped holes in a piece of strip-steel screwed to the end of the box, as shown in the illustrations. The sifting-plate needs no description, but it would be easier to fit a piece of coarse-mesh iron gauze, as used for cinder-sieves and suchlike; this is obtainable commercially, in grades from ⅛-in. mesh upwards, and the ordinary hand-sieve which I use for sifting the coal for my own engines, has a mesh of approximately 5/32 in. Incidentally, the last lot of coal supplied by our coal merchant for the Ideal heating boiler, consisted of anthracite peas (all he had—some say "good old Coal Board"!) and it is what the kiddies call "a job for life," to keep on shovelling up what falls through the bars, sifting out the ashes, and putting what is left, on the fire again. However, they say that it's an ill wind that blows nobody any good, and I can use the stuff on my little locomotives, just as it comes from the coal yard, without sifting or anything else, as it is free from dust. It makes plenty of steam, and less than an inch of it on "Jeanie Deans's" firebars keeps her right on the pin, despite the absence of audible blast.

Mr. Adams's crusher has no difficulty in dealing with Welsh steam coal, and ordinary household coal, also Coalite; he says he hasn't tried hard anthracite, but I should imagine it would only need a bit more "Sunny Jim" on the end of the operating lever. Anyway, it is an ingenious and useful gadget, and well worth the trouble of making up.

*UTILITY STEAM ENGINES

by Edgar T. Westbury

THE two foregoing examples of engines, which are much the same in internal capacity and essential working features, demonstrate that there is a good deal of latitude in external form and methods of construction. Readers often enquire as to the "best" form of design, and the "easiest" type of slide-valve engine to construct, but it is clear that both these factors are influenced by individual preference and available machining facilities. The constructor of a model marine engine, unless he is attempting a fairly true representative scale model, rarely emulates the structural design of the prototype, which, in the larger sizes of engines at least, generally incorporates a cast rear column, bearing the slideway for the crosshead on its front face, and solid bar or tubular front columns. While structurally sound, this is not easy to carry out accurately in small engines, and the alternatives, both of which are equally sound but not quite so good-looking, are the all-cast or all-bar forms of structure.

The former method facilitates the use of a trunk crosshead guide, which gives highly adequate bearing surface and rigidity both on the front and rear sides of the crosshead, and has the further advantage that accurate alignment of the guide can be positively assured by boring it at the same setting as the register for the bottom cylinder cover. When castings can readily be obtained and the means of machining them are available, this is one of the most satisfactory forms of construction, and is seen in some of the best-known examples of model steam engine design, including the Stuart No. 10, in both its vertical and horizontal forms, the Dick Simmonds design as illustrated on page 106 of the January 27th issue (it may be mentioned that this engine is also available in horizontal form), and in the very handsome Tangye-type horizontal engine, the castings for which were once available from the Liverpool Castings and Tool Supply Company.

The trunk column form of structure, however, is objected to by some constructors on account of weight, difficulty of machining, or unsuitability for production from bar stock, without the use of special castings. A further objection which has been cited against the trunk guide is that it is liable to make access to the piston-rod gland very difficult. In such cases, the four-bar column structure is often preferred, and although the rigidity of this is not equal to the trunk column type, especially in respect of the crosshead guide support, it has been proved highly satisfactory in practice, while its compactness and low weight are often a practical advantage. A notable example of this type of engine in the past was the Stuart "Simplex," which has formed the power unit of many good model steamers, and regrets have often been expressed that it is no longer available.

Such engines usually have bar crosshead guides, or in some cases a guide plate is attached to two of the columns, with suitable distance packings to bring it into alignment with the crosshead face. It is not, however, impossible to incorporate a cylindrical or short trunk guide, which may be machined as an integral part of a cylinder entablature plate, or an extension of the lower cylinder cover. This has been done in the case of the small but dynamic Stuart "Meteor" engine.

The "Trojan" Engine

An example of a bar column engine which is well suited to the purposes of the beginner with modest equipment is the MODEL ENGINEER design M6, known as the "Trojan" engine, of $\frac{5}{8}$-in. bore by $\frac{5}{8}$-in. stroke. This is based on an old MODEL ENGINEER design of proved soundness, and was produced in response to the request of many readers, who wished to build a utility engine either from castings or bar stock. While the drawings show parts intended primarily to be made from simple castings, there is no component which cannot readily be made from bar or sheet-metal stock; this may call for some modification of external shape, but no difference in essential features and dimensions.

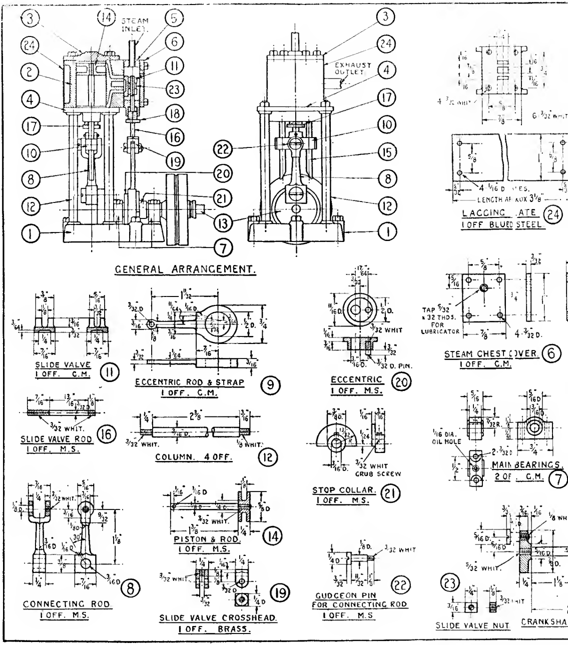
The bedplate (1) which forms the foundation of the engine structure is specified as a casting, but can be made from flat plate; it carries the main crankshaft bearings (7), and also the four pillars of round bar (12), which in turn support the entablature, integral with the lower cylinder cover (4). This component may also be made either from a casting, or fabricated from stock material; into the gland boss on its underside are screwed the two round slide-bars (15), which guide the crosshead (10), to which the piston-rod (14) is attached by a cross-pin.

No detailed comment is necessary concerning the cylinder block (2), with its top cover (3), steam-chest (5), and steam-chest cover (6), as these components are all of familiar design, and produced by methods which have often been described in THE MODEL ENGINEER, including the cutting of the ports and drilling of passage-ways. The same applies to the design and construction of the slide-valve (11) and its appurtenances.

The crankshaft (13) is of the overhung type, and built up by the simplest methods. If desired, the crank disc can be cut away to form a balance weight, which will reduce vibration if the engine is to be run at high speed. This form of crank avoids the need for split bearings, either in the case of the journals or the crankpin.

A useful feature of this engine, for certain purposes, is the slip eccentric reversing-gear, the principle of which is known to most readers, but in view of the many queries about it which have been encountered, a brief explanation will be desirable. This is the simplest method of reversing which can be applied to an ordinary

*Continued from page 109, "M.E.," January 27, 1949.



The " Trojan " ⅝" × ⅝" double-acting reversin

slide-valve engine, and it enables an engine to continue running in whichever way it is started, by allowing a determined amount of backlash or slip in the eccentric drive, so that it is timed appropriately to the direction of movement. The eccentric (20) itself is loose on the shaft (13), but is fitted with a driving-pin, which makes contact with the cutaway flange of the stop-collar (21) secured to the crankshaft.

To set the eccentric to give correct timing for both ahead and astern running, the length of the slide-valve rod (16), and the slide-valve nut (23),

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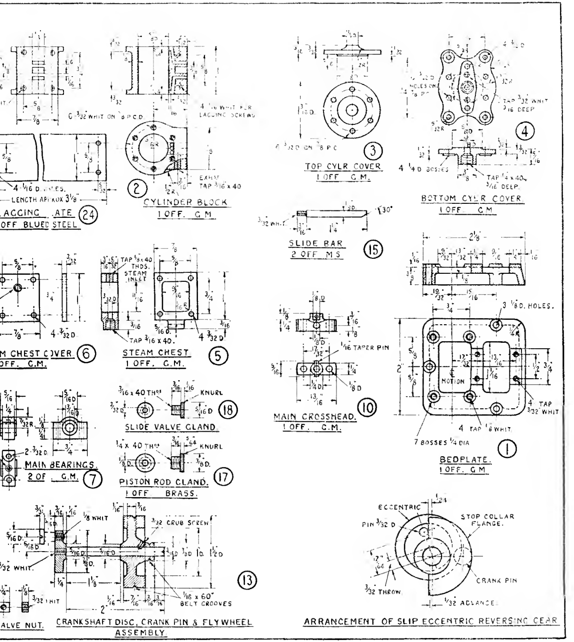

double-acting reversing steam engine

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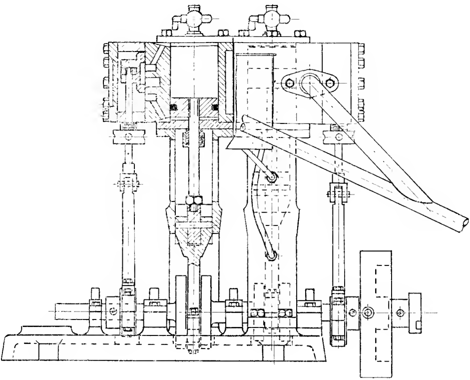
are first adjusted so that the movement of the slide-valve (11) is symmetrical, relative to the position of the ports in the face of the cylinder block (2); in other words, that the opening of the top and bottom steam ports are equal, when the eccentric is turned to bottom and top dead centre positions respectively. This should be done before securing the stop-collar to the shaft, or making any attempt to "time" the crank. The latter is now placed exactly on either its top or bottom dead centre, and the stop-collar placed and temporarily secured so that the eccentric has



Side elevation of the " Warrior " engine

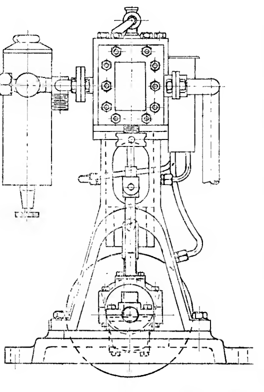
an equal limit of travel either way, in opposite phase to the crankpin, as indicated in the timing diagram. If the dimensions of the essential parts, that is, the slide-valve face, port spacing, eccentric throw, and stop-collar, are all correct, and the vertical position of the slide-valve properly adjusted as above described, the steam port should just show a very slight opening in either the top or bottom position when the eccentric is shifted to one or other extreme point between the flange stops, without moving the crankpin. A check should be made at the other dead centre position of the crankpin to make sure that the stop-collar is timed quite symmetrically, after which the latter can be firmly secured by drill-pointing a recess in the shaft to locate its grub-screw.

Any error in the amount of opening of the steam port at dead centres, or " lead," can be corrected by filing the flanges of the stop-collar. Should too much opening be given, the alternative to making a new stop-collar is to make a stop-pin with an enlarged head. In the event of no provision for reversing being required, the stop-collar can be replaced by a plain collar to prevent side movement of the eccentric strap, and this is either secured positively to the eccentric, or the latter itself locked to the shaft.

This engine will provide a suitable source of power for a model prototype boat up to 3 ft. in length, or more in the case of comparatively slowly-moving craft. One of them which I made many years ago for a friend to install in his model cargo boat is still working as merrily as ever, and no repairs or replacements, except piston and gland packings, have ever been necessary; the name of the engine, implying a sturdy and persistent toiler, is thus highly appropriate.

The " Warrior " Twin-cylinder Engine

Some eighteen years ago I was associated with the foundation of a model engineering society at a well-known Service training establishment, and I was asked to produce a design for a simple steam engine, the castings of which could be made in the foundry of the training workshops, and the machining carried out by the boys with the available equipment of the model engineering workshop. I decided on a vertical double-acting engine, with a cast trunk column and a cast bedplate, also a built-up overhung crank with a balanced disc; in short, a very " ordinary " design in which the emphasis was entirely on straightforward methods of construction. From the point of view of utility performance, the design was a very successful one, but I am bound to put on record the fact that comparatively few of the boys ever built this engine, being far more interested in constructing the " Atom III " petrol engine, which I designed at about the same time. When I left this establishment I found that quite a number of model engineers in London were



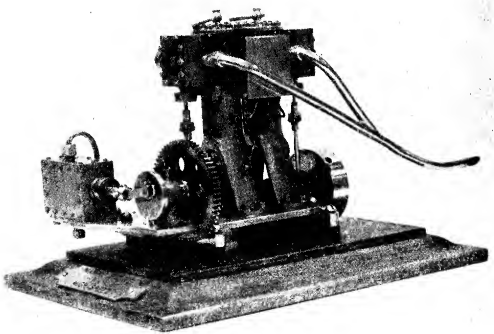
interested in an engine of this type, so I handed over the design to a well-known dealer in model supplies. I have reason to believe that quite a number of these engines have been built, though the dealer referred to, for some reason best known to himself, avoided any reference to my name in connection with the design, and the only evidence of its origin was the letter W cast on the steam-chest cover. An engine of this design was constructed by my friend Mr. A. D. Trollope, and ran successfully for several years in his model steam yacht.

Within recent years, interest in this design has been reawakened by its metamorphosis into a very workmanlike twin-cylinder design by Mr. Ganzell, of the Imperia Engineering Company, 4, Cranbrook Road, Ilford. In this form, the upper structure and trunk columns of the engine remain essentially the same as in the original design, but I have designed a new bedplate, and it has, of course, been necessary to incorporate a two-throw crank, with split bearings for the main journals and crankpins. So far as possible, however, the straight-forward constructional design has been

(*Continued on page* 174)

Left—End elevation of the "Warrior" engine

Below—The "Warrior" $\frac{3}{4}$ in. × $\frac{3}{4}$ in. twin-cylinder double-acting engine, with geared feed pump



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TRADE TOPICS

Steam Locomotives for "O" Gauge

We have received from **Norman Dewhirst,** 46, Crescent Road, Great Baddow, Chelmsford, a set of blueprints consisting of particulars and drawings for the construction of a 4-6-0 type steam driven tender locomotive for "O" gauge. The design possesses some novel features which are the result of several years of practical experiment. These features are clearly set out and explained on the first sheet of the set of blueprints, the total number of sheets of which is eighteen. The main difficulties with true-scale steam models in "O" gauge have usually been: to ensure that the boiler can provide enough steam to develop real power in the cylinders long enough to enable the engine to haul a realistic train for a reasonable time; to keep the construction as simple as possible, and to maintain a satisfactorily realistic appearance.

Mr. Dewhirst seems to have overcome all these difficulties in a most ingenious way, and he has himself been hauled by each of two locomotives, one a G.W. "County" and the other a Stanier "Class 5," built to his designs as fully set out in the drawings. The drawings suit either type of engine, with some very slight modifications which, however, are very clearly indicated. There is not a single item that is not shown, and every necessary dimension is given.

The methods by which the results are obtained are, to some extent, startling in the boldness of their conception; but there certainly seems to be no doubt of their effectiveness, and we anticipate that when they become more generally known, they will lead to further developments in "O"-gauge steam locomotive construction. The drawings may seem, at first sight, to be somewhat elaborate. Actually, they are not; they are certainly numerous, but they are commendably clear, comprehensive and self-explanatory, and we feel that they are destined to promote widespread interest.

Price List Received

H. Clarkson, of Selby, Yorks, has favoured us with a copy of his new price list of castings, parts and other useful items for building up miniature locomotives. Mr. Clarkson specialises in models of L.N.E.R. locomotives such as the B1 and B2 classes of 4-6-0, the A3 class 4-6-2 and the L1 class 2-6-4 tank, all in ¾ in. scale. In "O" gauge, there is an exceedingly accurate model of a Gresley A3 4-6-2, electrically driven, and for Gauge 1, an attractive 10-mm. scale *ex*-G.N.R. saddle-tank, also electrically driven.

The illustrations show that the ¾-in. scale, high-pressure steam models are unusually faithful reproductions of their prototypes. The price of the list is 6d.

FOR THE BOOKSHELF

A Two-tool Back Tool-post, by "Duplex." (London: Percival Marshall & Co. Ltd.) Price 2s. 0d. net.

This is a 14-page brochure, nicely produced on art paper, describing and illustrating the construction of a very handy little implement for attaching to the cross-slide of almost any type of small lathe. The various stages of machining the castings and other components are clearly described and illustrated, whilst, at the end, Mr. E. T. Westbury contributes a brief commentary on the method of using the finished tool-post. The necessary castings for the tool-post are obtainable from Mr. W. H. Haselgrove, of Petts Wood, Kent; we can commend the book, the tool-post and the castings to all readers who want to make up a simple, accurate and useful addition to workshop equipment. The name "Duplex" requires no introduction to our readers, and is a sufficient guarantee of the excellence of this attractive little attachment.

Locomotives through the Lens. By P. Ransome-Wallis. (London: Ian Allan Ltd.) Price 7s. 6d. net.

A common trait among locomotive enthusiasts is an insatiable appetite for locomotive photographs. To such people, this book will make an instant appeal, for its contents consist of: A Foreword by Sir William A. Stanier, F.R.S.; two pages of "Introduction" by the author; and the other 93 pages are packed with locomotive photographs. Dr. Ransome-Wallis is one of our really expert railway photographers, and his book has every appearance of having been deliberately planned during the period covered by this splendid collection of pictures—1923 to 1947. The four main-line railways of the pre-nationalisation era, alone, are included; but there is something to please everybody who had a "favourite" railway in England, Scotland, or Wales during the last twenty-five years of the L.M.S.R., L.N.E.R., G.W.R. and S.R. as separate entities.

The production and presentation are well worthy of the subject and contribute no small share to the attractiveness of this book.

Railway Map of England, Wales and Scotland. (London: Ian Allan Ltd.) 56 pages, size 7½ in. by 4½ in. Price 8s. 6d. net.

An extremely useful item in the home or office library is a railway map which is clearly legible without being of unwieldy size. This map fills that requirement admirably; it is presented in the form of an atlas, showing the disposition of all four of the pre-nationalisation main line railways, each in a distinctive colour, and the minor railways which were operating in 1947. Every station is marked, each page is divided into 10-mile squares and there are thirteen pages of index to stations. The atlas is based on the official Railway Clearing House maps and, therefore, authentic.

*B.H.P. Tests on Petrol Engines

by R. E. Mitchell

THE crankshaft was produced by machining each journal and its crank disc from 3 per cent. nickel steel. The journals were nominally of $\frac{3}{8}$ in. diameter, but were machined to such a size as to be a press fit in the ball-race bores. A new connecting-rod was required and this was produced by machining from wrought duralumin bar by the normal methods and had the usual I-section. In the original design the crankpin had a diameter of $\frac{3}{8}$ in. It was decided to increase this to $\frac{1}{2}$ in. diameter in order to reduce the loading on this bearing. The little end diameter is 7 mm. A $\frac{1}{4}$ in. diameter gudgeon pin had originally been used but the hole to accommodate oversize and carburised rather deeply, being allowed to cool down in the furnace. Air cooling of such a small bar would most likely result in hardening of the case sufficiently to render subsequent machining difficult. The bar was then machined to a running fit in the connecting-rod and reduced at each end to such a diameter as to produce a press fit in the $\frac{5}{16}$ in. diameter reamed holes in the crank webs and screwed $\frac{5}{16}$ in. $\times$ 26 t.p.i. at each end. After completion of the machining the crankpin was hardened and cleaned up afterwards. This method had to be resorted to since no cylindrical grinding equipment was available.

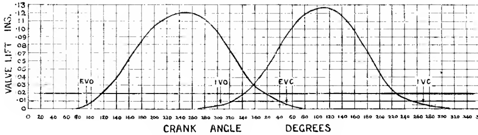


Fig. 5. Valve events given by the cams shown in Fig. 6

this in the piston had not been bored exactly at right-angles to the axis of the piston, and in the process of rectification, the diameter was increased to 7 mm., a new gudgeon pin being made to suit. This was carried out before consideration of the present design and it was desired to make use of the existing pin which was in excellent condition. The crankpin was machined from 3 per cent. nickel steel. A bar of this material was turned to about 0.005 in.

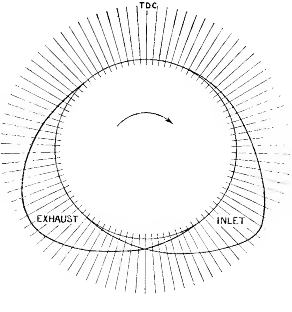


Fig. 6. The cam profiles which give the valve timing as shown in Fig. 5

The usual oil passages were drilled in one half of the crankshaft to convey oil from the plain support bearing at the flywheel end to the big-end bearing. The connecting-rod was threaded on to the crankpin and the crankshaft was assembled. The nuts on the crankpin, also of high tensile steel, were tightened as much as possible and a $\frac{5}{64}$ in. diameter peg was driven into a drilled hole in the crank disc half-way along the most accessible flat of each nut. This method of locking is plainly visible in Figs. 3 and 4. On assembly the crankshaft

*Continued from page 143, "M.E.," February 3 1949.

ran true to within 0.0005 in. which was considered satisfactory. It is not intended that the crankshaft assembly should be dismantled except for the renewal of parts.

New timing gears and camshaft were also necessary. 25 d.p. wheels had been used on the previous design and these were rather too coarse. The new diametral pitch and number of teeth were governed by the minimum centre distance available between the main and camshaft ball-races, together with the dividing equipment available. The outside diameters of the ball-races are $\frac{7}{8}$ in. for the main bearing and $\frac{5}{8}$ in. for the camshaft bearing. The final sizes decided upon were wheels of 38 d.p. having 20 and 40 teeth respectively. These required a centre distance of 0.79 in. thus leaving 0.04 in. of metal between the ball-races. The gear wheels are $\frac{3}{16}$ in. wide and were cut by planing in the lathe using a form tool. The 20-tooth pinion together with the oil pump worm, which is $\frac{3}{4}$ in. diameter, were machined in one piece and case-hardened after which they were pinned to the crankshaft. The camshaft gear wheel is this time separate

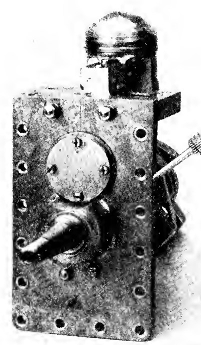


Fig. 7. Magnesium alloy timing case and dural ball-race end-cap, showing the difference in corrosion resistance

from the camshaft and was prepared from mild-steel and left in the normalised condition. A somewhat different valve timing was decided upon. Both valves are to open earlier and close later, thus favouring high-speed operation while deriving any scavenging advantage there may be gained by using a tuned exhaust pipe and the ram effect from a similarly tuned induction pipe. Although it is not possible at the moment to carry out tests with these refinements, the present tests being confined to an exhaust pipe and silencer with plain carburettor as before.

Suitable valve lift/crank angle curves were drawn corresponding to the desired valve events.

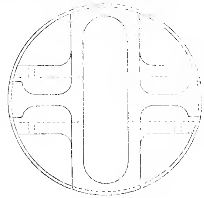
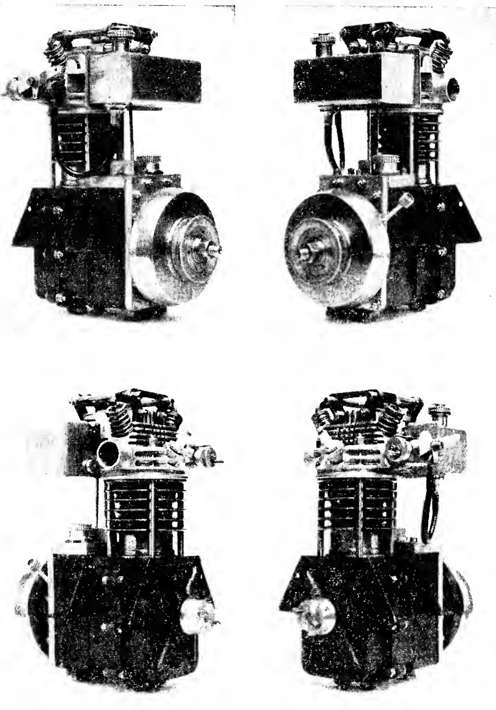


Fig. 8. Sketch showing the underneath view of the piston

The curves chosen are almost harmonic, opening and closing the valves very gradually. From these curves the cam lift at various camshaft angles can be read off. The camshaft was prepared from alloy steel leaving two complete discs each $\frac{3}{16}$ in. wide for the cams. A base circle of $\frac{1}{2}$ in. diameter is used. The shaft was indexed by means of a 90-tooth wheel as a division plate. Thus one tooth is equivalent to 4 deg. of camshaft angle or 8 deg. of crankshaft angle. The cam blanks were then filed with the aid of a filing rest secured to the vertical slide using the graduated dial to give the cam lift. This method gives a cam having 90 flats around its periphery which can easily be smoothed off afterwards with a fine file. Since flat bottomed tappets are used it is unnecessary to draw the actual cam profile since the file behaves as a flat bottomed tappet and generates the correct profile. Fig. 5 shows the timing actually obtained by this method. These figures were taken from the completed engine, measuring the valve lift with a dial gauge and indexing the flywheel by means of a circular protractor fastened to it. It will be seen that the lifts are 0.121 in. and 0.128 in. These were intended to have the same value of 0.125 in. and are due to inaccuracies in the method used for their manufacture. Also the exhaust valve opens rather more rapidly than was intended. Fig. 6 shows the cam profiles which give the above valve events. The circle is divided into 90 divisions showing the effect of using a 90-tooth wheel as a division plate. A tappet clearance of 0.005 in. was allowed for in the design. The valve timing which finally resulted is as follows :

Inlet opens 52 deg. before t.d.c.
Inlet closes 90 deg. after b.d.c.
Exhaust opens 87 deg. before b.d.c.
Exhaust closes 50 deg. after t.d.c.



Figs. 9, 10, 11 and 12. Four views of the completed engine

The engine was roughly assembled to get the correct orientation of the timing wheel relative to the cams. A 5/64 in. diameter hole was then drilled through the gear wheel boss, and the shaft. The camshaft was then hardened right through in oil and given a low temperature tempering treatment. The ball-races which have a ¼ in. diameter bore were fitted to the shaft by lapping the journals after hardening and the gear wheel was pinned to the shaft.

The tappets were prepared from 3 per cent. nickel steel having the parallel portion 5/32 in. diameter, and the bases 3/16 in. wide × 7/16 in. long. A hemispherical depression was drilled in the end to take the push rods, which were prepared from 13-gauge steel knitting needles as before. The tappets were case-hardened and oscillate in unbushed reamed holes in the magnesium alloy top cover of the timing case. To prevent the tappets from revolving, two ⅛ in. diameter pegs are driven into the cover between the tappets. This cover also incorporates the oil filling plug which acts as the crankcase breather. Fig. 7 shows the front and top timing case covers and is interesting in that it shows the relative corrosion resistance of magnesium alloy and duralumin. Both the covers are in magnesium alloy while the camshaft ball-race cover, held by four cheese-head screws, is in duralumin. Both were originally of similar smoothness and brightness and the photograph was taken after the conclusion of these tests and is the result of about four months indoor corrosion in reasonably dry conditions. Clear lacquering of the external parts prepared from this material has since been used and affords a large measure of protection.

The compression ratio in the previous design was only a moderate 6.5 : 1. An increase in efficiency would most likely result from a higher value. A new piston was therefore required and this was machined from the solid and is of magnesium alloy. A compression ratio of about 10 : 1 was aimed at and in order to take advantage of the increased explosion pressure two piston rings were thought to be necessary. In order that the ring pressure should not be increased two rings each of 0.035 in. depth were attempted. To reduce the area of the piston in contact with the cylinder to a minimum, a skirt of cruciform section was used. Only the top land is cylindrical being of 1.064 in. diameter thus allowing a clearance of 0.005 in. The skirt was milled away as shown in the sketch, Fig. 8, and the two photographs, Figs. 3 and 4. Four lands each 5/16 in. deep with a clearance of 0.003 in. were left situated at 90 deg. intervals around the periphery of the skirt. The webs between these lands and the top of the piston were considerably relieved to the extent of 0.04 in. A few circumferential grooves were machined in the vicinity of the piston rings to aid in gas retention. These can be differentiated from the piston rings in Fig. 4 where the piston ring gaps are visible. The milling was straightforward since there are no accurate dimensions to be adhered to and was carried out on a vertical slide using a short ¼-in. drill as a milling cutter. The cutting end was ground spherically so as to leave a reasonable radius in the corners. In order to machine the piston crown correctly, molten Wood's metal was poured into the cylinder-head, the sparking plug hole being filled with plasticine, to obtain a male impression of the cylinder-head. The profile of this casting was copied by milling and scraping. Suitable valve clearances of about 0.03 in. and plug clearance were allowed together with concentrating the combustion space around the sparking plug. The piston rings were prepared from cast-iron bar as often described in THE MODEL ENGINEER and presented no difficulty in spite of the reduced section. The blanks used were 1⅛ in. outside diameter × 1 in. inside diameter with the 45 deg. slot machined with a 1/16 in. wide cutter. In previous designs magnesium alloy end pads had been used for the gudgeon pin. These had slightly scored the cylinder walls. To avoid this the gudgeon pin was shortened to 0.74 in., to save a little reciprocating weight, and located laterally by a piece of piano wire at each end through diametrically opposite holes. The ends of the wire were bent over at right-angles and were sufficiently short to prevent contact with the cylinder walls. When completed the compression ratio was found to be 14.4 : 1 but it was decided to try out the performance before carrying out any alteration.

(To be continued)

UTILITY STEAM ENGINES

(Continued from page 169)

retained, and without making any sweeping claims for what is obviously just another "common or garden" slide-valve engine, I can say that, if reasonably well made, the efficiency is good, and steam economy rather better than most engines in this class which have been tested. Some attempt has been made to make it look like a "real" engine, without incorporating delicate detail work which would confer no practical advantage, but on the other hand might tend to lower its reliability. In view of my direct association with the evolution of this design, I propose to devote some space to the details of its construction, and methods of machining.

Should it be felt that the elementary treatment of this subject is beneath the notice of more advanced readers, let me remind them again that the whole object of this series is to comply with numerous requests from inexperienced readers who appear to have found great difficulty in obtaining information to tide them over the problem of constructing their first steam engine.

(To be continued)

A general view of the site

NEW LOCOMOTIVE TRACK AT HUDDERSFIELD

As stated in a recent "Club Announcement" the Society's continuous track round the boating pond at Highfields is now complete. Such a scheme had long been the dream of one or two members, and last year in view of the number of locomotives built or building, it seemed that the necessary support would be forthcoming and this has proved to be the case, the job being done inside five months.

The track consists of two semi-circles of 66 ft. diameter connected by 120 ft. of straight, and caters for $7\frac{1}{4}$ in., 5 in., $3\frac{1}{2}$ in. and $2\frac{1}{2}$ in. gauges. It is of substantial construction, the two outer rails being $1\frac{1}{2}$ in. $\times$ $\frac{1}{2}$ in. and the three inner $1\frac{1}{2}$ in. $\times$ $\frac{3}{16}$ in. black mild-steel held together by $\frac{3}{8}$-in. bolts, and spacers made from $\frac{3}{4}$-in. gaspipes, the straights being in 17 ft. 6 in. lengths and the curves in 15 ft. lengths with supporting posts at 5 ft. and 5 ft. 10 in. centres respectively.

It is satisfactory to find absolutely no tendency to "porpoise" as is the case on some similar tracks of lighter construction due to the sag between posts, and which was noticed on the earlier track where 2 in. deep section was used with posts at 8 ft. 6 in. centres.

The method of getting the posts to the same level may be of interest. Railway sleepers were used, and they were first roughly cut in half and the halves then planted in their correct positions with a minimum of 2 ft. in the ground, but not bothering much about height at this stage. They were tamped firm and then the tops were sawn off with a crosscut saw working on guides clamped to the post, the guides being levelled from the surface of the pond by means of a straight-edge, a spirit-level and a float. The guides were set at an angle across the post where necessary, to provide super-elevation, and the posts when sawn off were coated with bitumen compound and covered with roofing-felt to protect the end grain.

The curved sections of track were made from straight rails, the outer one being 15 ft. long, the next a carefully-calculated amount shorter, the next shorter again and so on, and then each divided up equally into 16 and drilled. When bolted together, the sections pulled into a very sweet and accurate curve and were as rigid as roof-trusses; in fact, it has not been found necessary to fix the track to the posts in any way—it does not shift even with a $7\frac{1}{4}$-in. gauge engine and a train of 11 adults hitting the curve at speed. There was difficulty in avoiding kinks at the joints, due to the natural tendency of the

Gauge	*Type*		*Complete*	*Building*
$7\frac{1}{4}$ in.	" Duchess "	4-6-2 tender		2
Do.	" Midge "	0-4-0 tank	1	
Do.	Free-lance	0-4-0 tank	1	
5 in.	" Maid of Kent "	4-4-0 tender		1
Do.	" Minx "	0-6-0 tender		2
Do.	Free-lance	0-4-2 tank		1
Do.	Free-lance	0-4-0 tank	1	1
$3\frac{1}{2}$ in.	" Princess Royal "	4-6-2 tender	1	1
Do.	Free-lance	4-6-2 tender	1	
Do.	" Heilan' Lassie "	4-6-2 tender		3
Do.	" Cardean "	4-6-0 tender	1	
Do.	" 5 X P "	4-6-0 tender	1	
Do.	" Bantam Cock "	2-6-2 tender	1	4
Do.	" 1000 Class "	4-6-0 tender		2
Do.	" Maisie "	4-4-2 tender	1	
Do.	" Fowler Mogul "	2-6-0 tender	1	
Do.	" Mollie "	0-6-0 tender	1	
Do.	" Petrolea "	2-4-0 tender		2
Do.	" Juliet "	0-4-0 tank		3
Do.	Free-lance	0-4-0 tank	1	
Do.	" Rainhill "	2-2-0 tender		2
$2\frac{1}{2}$ in.	Free-lance	4-4-0 tender	1	
Do.	" Dyak "	2-6-0 tender	1	
Do.	" Southern Maid "	0-6-0 tender		1

An analysis of the Society's locomotive stock

Some of the members with their boats and locomotives

The president with his " Belinda " and train ready for traffic

rail-ends to straighten out, but this was overcome by using substantial fishplates, 1 in. × ½ in. section, 6 in. long, one to the inside of each rail, and these give just enough to allow the curve to be constant through the joints.

At the same time as the track work was in progress, a set of three passenger bogies were designed and built, and as these have several unconventional features, and have proved very satisfactory both on straight up-and-down work in the Municipal Park, on the continuous track, it is proposed to make them the subject of a separate article at a later date, but in the meantime an analysis of the Society's locomotive stock—some of which are illustrated herewith—may be of interest.

PRACTICAL LETTERS

Willans Steam Engines

DEAR SIR,—I was naturally pleased to see that the description of my father's two-crank compound engine was of interest. My experience of White Cars makes me confident of the ability of piston-valves to stand up to high superheat. Leakage past the tail-rod would be guarded against by making the parts easily replaceable.

I am, at the moment, gathering material for a biography of my father and, in consequence, am intensely interested in H. E. Rendall's letter and the illustrations from an old Tangye catalogue. Tangye's departed from my father's basic ideas and the engine as built by them was not successful. They built a large number, however, and one was operating a hoist in their works down to about the year 1900.

Mr. Rendall touches on a point that is an interesting one. Why did the engine fade out ? The reason was the invention of the central-valve engine, the sudden and tremendous expansion of electric lighting and power, and the death of the inventor. The three-crank engine working on the principle of the Tangye engine was a very good engine indeed, very silent, very simple and durable, and as economical as any engine of the period of similar size, but not as designed by Tangye.

The chief defect lay in the length of the steam ports, and I feel sure that this would have been overcome had my father lived and gone on with its manufacture.

The last engine of this type that I saw running was one of about 160 I.H.P. in a yacht named *Scaup*. I drove that engine, as a result of a chance meeting with the owner, and found that the yacht, which was delivered to its first owner in 1892, had had two replace boilers and a new bottom, while the engine had had little or nothing done to it. I drove the engine in the year 1929, and some two years later the hull was so decrepit that it was not worth repairing, and she was scrapped.

I was told only recently that an engine of the type was built by Hunter and English, who had a licence, in about 1902, and this is still in existence on the P.L.A. floating crane *Leviathan*, where it is used to run the counterbalance weight in and out.

I do hope that Mr. Rendall will some day let me have a look at the catalogue from which the engravings were taken, and, in return, I shall be only too pleased to give him any information that I possess relative to the engines.

Yours faithfully,

Ilminster. KYRLE W. WILLANS.

A Seismograph

DEAR SIR,—Many years ago as a printers' apprentice at a firm in Fetter Lane, London, I often helped to print a publication called *The English Mechanic and World of Science*. It was a veritable mine of information, covering the whole field of human knowledge. Its contributors were numbered among some of the greatest scientists of the day. One of its most frequent contributors was a Mr. Hollis, who wrote on astronomical matters. Another was the late Mr. Shaw of Bromwich, a great seismographical expert. I remember he contributed an article on an instrument he had made; drawings, dimensions, etc.—this must have been somewhere about 1912. Reference to the indexes will find it; bound volumes, going back many, many years, can be seen in the Patent Office Library off Chancery Lane, Holborn, London, W.C.2.

Yours faithfully,
London. W. ADDISON.

DEAR SIR,—With reference to Mr. Hollis's enquiry, the late Father O'Leary, S.J., designed and constructed a seismograph at the Jesuit Monastery, Rathfarnham Castle, Dublin, about 25 or 30 years ago. Subsequently, a second seismograph was erected at the Castle and the two instruments now form a recognised seismograph observatory where a continuous record is kept. The observatory adjoins the entrance to the Castle over which considerable heavy traffic passes and is also quite near a main road. If enquiry be made to the Reverend H. Kelly, S.J., Rector, Rathfarnham Castle, Rathfarnham, Dublin, it is possible that your correspondent may be able to obtain the information he requires, and, if such information would be of general interest to your readers, permission might be obtained for publication.

Yours faithfully,
Rathfarnham. DESMOND MORAN.

Melting Points

DEAR SIR,—With reference to Mr. A. R. Turpin's very masterly article on thermocouples appearing in the January 13th issue of THE MODEL ENGINEER, may I be permitted to make the following observations?

(a) The melting point of tin is 232 deg. C., not 271 deg. C. as stated.

(b) Pure silver melts at 1,083 deg. C. only when covered with a thin layer of powdered coal (or similarly protected from oxidation). When melted in air it is nearer 1,050 deg. C. Further, if no precautions are taken to prevent the molten silver from absorbing oxygen from the air, it will "spurt" on solidifying, producing a porous unsightly ingot.

(c) A very useful melting point not quoted is that of ordinary cooking salt (sodium chloride) at 801.5 deg. C.

(d) Oxidation of the twister wires of the hot junction leads to erratic results. It is much better to have the wires brazed, or better welded, together. Brazing can only be used when the maximum operating temperature does not exceed a blood-red heat (700 deg. C.), of course.

Yours faithfully,
Southsea. D. BIRCHON.

A Simple Electric Pyrometer

DEAR SIR,—I refer to the article on the above subject by A. R. Turpin in your issue dated January 13th, in which I find a number of errors. In the second paragraph, col. 2, p. 54, Seger Cones Nos. 022 and 021 are both indicated as fusing at 600 deg. C., which is obviously wrong. Not having a table of Seger Cone Fusing Temperatures for the lower numbers, I cannot say which of the two numbers the stated temperature actually refers.

In Fig. 1, the cone with the *highest* melting point is shown completely collapsed, whereas the cone with the *lowest* melting point is still in its original form. The shapes shown for Nos. 02 and 2 should be interchanged, and similarly the shapes of Nos. 01 and 1 should be interchanged.

In the list of metals suggested for calibration purposes in col. 2, p. 56, the melting point of tin is given as 271 deg. C., whereas it is actually 231.85 deg. C. (N.P.L. Report, 1928).

One easily obtainable substance for calibration is common salt, which solidifies at 801 deg. C. If this is used as a calibration material, care must be taken to wash it very thoroughly off the couple immediately after the check is made, otherwise the couple will corrode rapidly.

Yours faithfully,
Heston. JAMES A. LIVIE.

Metric Measurements

DEAR SIR,—It is regrettable that your contributor, Mr. T. Brown, should have chosen to use the metric system to dimension the drawings of his small "diesel" engine. By so doing he has ensured that no, or very few, replicas of his model will be produced. I, for one, have no measuring instruments, save a rule, graduated in mm., and I certainly do not feel inclined to wade through the mass of conversions necessary to bring the dimensions to inches.

As for the limits—well! We are model, not production, engineers.

Yours faithfully,
Huddersfield. ALAN WHITELEY, A.I.Mech.E.

The Compound Tractor

DEAR SIR,—I was interested to note that Mr. Steel has unearthed Aveling & Porters' one and only failure. I could never understand why they ever dared to build an engine with 180 deg. cranks when the essence of easy starting is the 90 deg. setting.

This engine was as bad as a single-cylinder engine for getting on dead centre, and they only made the one. It might just as well have been a single-cylinder engine because the economy of a compound on the road is very doubtful, especially if there is much starting and stopping.

People may ask why Burrells built a single-crank compound. The reason was to evade a sales agreement and sell a compound at the price of a simple; it certainly was economical on stationary work.

If Aveling & Porters had wanted to gain a saving in parts, they should have used a single transfer valve.

Yours faithfully,
Oxford. F. J. BRETHERTON.